15 NOV. 1921

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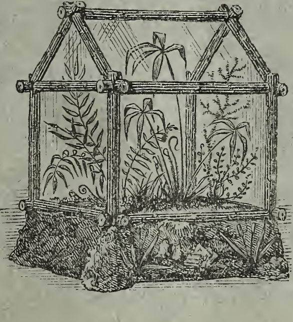
FERNS AND FERNERIES

BY THE AUTHOR OF

"ANATOMY OF AN EARTHWORM," "HAIRS AND SCALES"
"MANUAL OF MOUNTING," ETC.

Vita sine literis mors est

Illustrations drawn by the Author



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BRITISH MUSEUM
NATURAL HISTORY

Vita sine literis mors est

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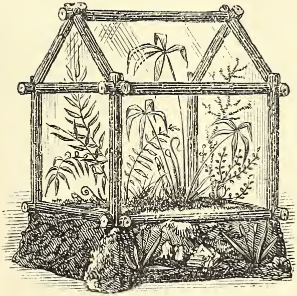

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" In its case,
Russet and rude, folds up the tender germ
Uninjured, with inimitable art;
And, ere one flowery season fades and dies,
Designs the blooming wonders of the next."

"Where the copsewood is the greenest,
Where the fountain glistens sheenest,
Where the morning dew lies longest,
There the Lady Fern grows strongest."

" In all places, then, and in all seasons,
Flowers expand their light and soul-like wings,
Teaching us, by most persuasive reasons,
How akin they are to human things."

15 NOV. 1921

PREFACE.

In this work it has been our intention as far as possible to guide our readers to the grateful end, when after days of toil they see around them proofs of their studied labour. Like nearly all work which springs from a healthy brain, the cultivation of Ferns gives its own reward. To an inventive mind the following work is but a suggestion, and to him the expense will be but nominal. The Author would be pleased to receive any suggestions in regard to future editions, as he desires to make the work useful to the million.

THE AUTHOR.

August 1880.

FERNS AND FERNERIES.

ABOUT forty years ago Ferns first began to attract popular attention. Previous to this, though botanically studied, ferns were not generally grown, except in green or hot houses for the use of the special few.

In the International Exhibition of 1851 ferns for ornamental purposes were widely used, even more so than plants of gorgeous hue; from that time we may date their more extended popularity. This popularity has extended more from the delicate beauty of the forms than from colour. With a few exceptions their natural colour is less brilliant than grasses, shrubs, and flowering plants.

Most people can certainly recognise the Brake Fern (*Pteris aquilina*), commonly called the "Bracken," especially in the early autumnal months; some, too, will probably call the Male Fern (*Lastrea filix-mas*), the Hard Fern (*Blechnum spicant*), or the Hart's Tongue Fern (*Scolopendrium vulgare*) by their right names; but as to the distinction between the Male Fern (*Lastrea filix-mas*) and the Lady Fern (*Athyrium filix-fœmina*), the Hard Fern (*Blechnum spicant*) and the Common Polypody (*Polypodium vulgare*), they will be quite at fault, or make a vague guess at most, while the less frequent species are to them utterly nameless, useless, and unknown.

Although the knowledge of names is comparatively a very poor acquisition of knowledge, still it is obvious that one of the first essential steps in acquiring specific information in regard to an object is clearly and truly to identify that object with its name. It will therefore be evident that though the ferns of Great Britain occupy only about one-fortieth part of the ferns already known, still they must have specific names, and be arranged in a practical connected series. The natural orders comprising the British ferns are—*Polypodiaceæ*, where the capsules (*sporangia*) are seated on the dorsal, or the marginal part of the frond (figs. 1, 2); *Osmundaceæ*, where the capsules are clustered on the margin of a transformed frond (fig. 3); and the *Ophioglossaceæ*, where the capsules are arranged on the margin of a contracted frond (fig. 4).

It is advisable in beginning the study of ferns to

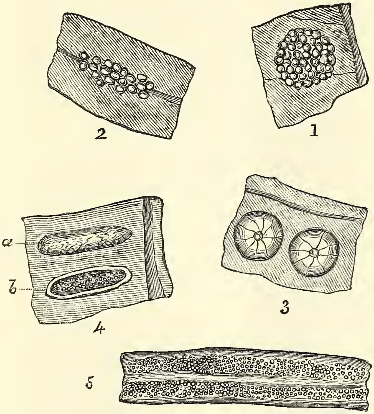

Fig. 1.

observe well these characters. The Maiden-hair and the Male Fern will give good examples, if you choose a *fertile frond*, of the order *Polypodiaceæ*. Again, the Royal Flowering Fern (*Osmunda regális*), fig. 3, will give a good example of the order (which is a small one)

Osmundaceæ; and the Adder's Tongue (*Ophioglossum vulgatum*), fig. 4, of the natural order *Ophioglossaceæ*. In passing it is advisable to mention that the so-called Club Mosses, order *Lycopodiaceæ*, may be considered

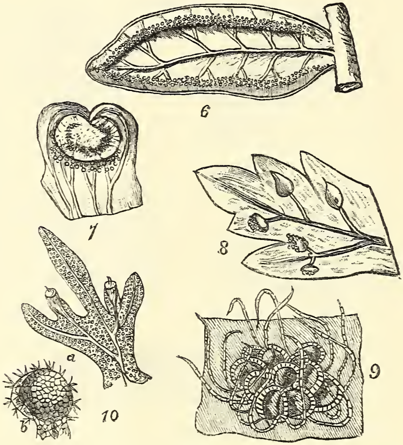

Fig. 2.

as a link between the ferns and the lower acrogenous forms of vegetable life.

The question is often asked, which are the best hardy British and Foreign ferns for an outdoor fernery? The following are a few of the best:—

British Ferns.

The Royal Flowering Fern (*Osmunda regalis*); Common Scale Fern (*Ceterach officinarum*), fig. 5; Common Polypody (*Polypodium vulgare*), fig. 6; Holly Fern (*Polystichum Lonchitis*); Male Fern (*Lastrea filix-mas*); Bladder Fern (*Cystopteris fragilis*); Wall Rue or Wall Spleenwort (*Asplénium

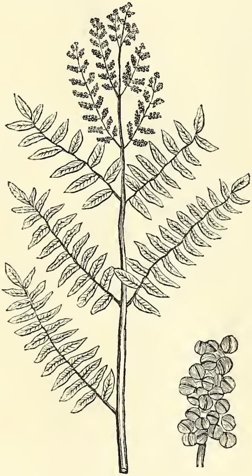

Fig. 3.

Rúta-muraria), fig. 7; Common Maiden-hair Spleenwort (*Asplenium Trichómanes*) fig. 8; the Black

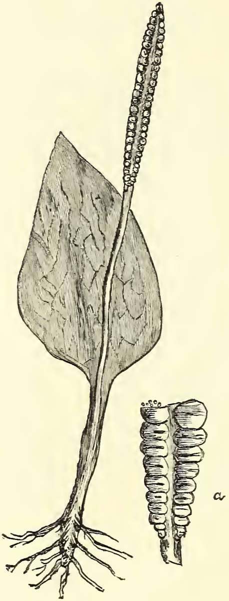

Fig. 4.

Maiden-hair Spleenwort (*Asplenium Adiantum-nigrum*); Lady Fern (*Asplenium filix-fœmina*); Hart's Tongue

Fern (*Scolopendrium vulgare*); the Brake Fern, "Bracken" (*Pteris aquilina*); Hard Fern (*Blechnum boreale* or *B. spicant*); Limestone Polypody (*Polypodium Robertianum* or *P. calcareum*); the Alpine Polypody (*Polypodium alpestre*); the Mountain Parsley or Rock Brake (*Allosorus crispus*); Common Prickly Shield

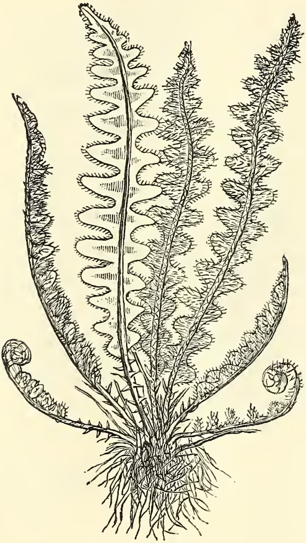

Fig. 5.

Fern (*Polystichum aculeatum*); the Mountain Lastrea (*Lastrea montana*); the Rigid Buckler Fern (*Lastrea rigida*); the Crested Buckler Fern (*Lastrea cristata*, var. *Spinulosa*); the Broad Buckler Fern (*Lastrea dilatata*); the Brittle Bladder Fern (*Cystopteris fragilis*);

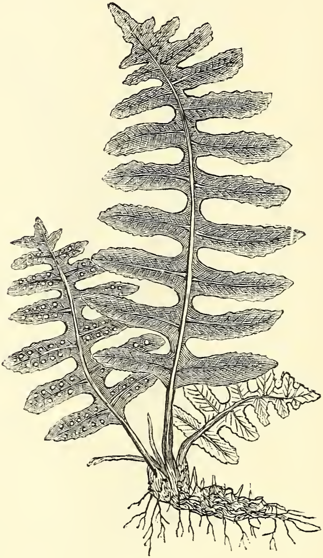

Fig. 6.

the European Bristle Fern (*Trichomanes radicans*); the Common Adder's Tongue (*Ophioglossum vulgatum*), fig. 4.

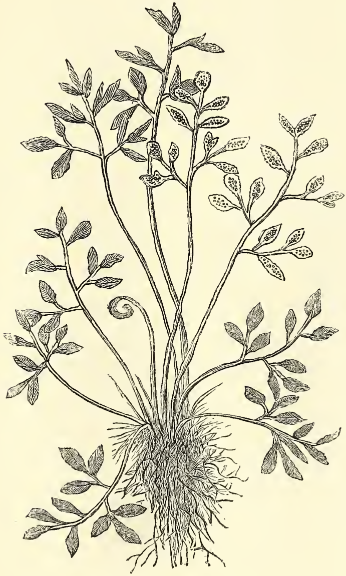

Fig. 7.

FOREIGN FERNS.

The Ostrich Fern (*Struthiopteris Germanica*); Clayton's Osmund (*Osmunda Claytoniana*); the Florida Fern

(*Woodwardia areolata*); the Virginia Fern (*Woodwardia Virginica*); the Narrow-leaved Spleenwort (*Asplenium angustifolium*); the Hardy Maiden-hair (*Adiantum pedatum*); Goldin's Fern (*Lastrea Goldiana*); and *Onoclea sensibilis*, etc.

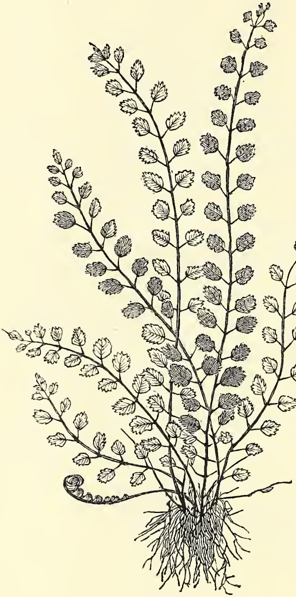

Fig. 8.

Having thus briefly mentioned a few of the most common ferns, we must now consider the growth and structure of a fern, taking as our typical specimen the Bracken or Brake Fern (*Pteris aquilina*). This can be commonly found in nearly all parts of Great Britain. A good fertile frond may be readily known by the back of the frond having dark-coloured bodies (*sori*) near the edge of each division (*pinnæ*). These *sori* when ripe discharge round spore-cases called sporangia. In most ferns these spore-cases are surrounded by an elastic ring (*annulus*), fig. 9, *c*. When the ripe dryness of the *sori* causes the membrane (*indusium*) which covers the sporangia (fig. 10, *a*) to split or shrink up, these spore-cases fall out, and almost immediately, unless they should be

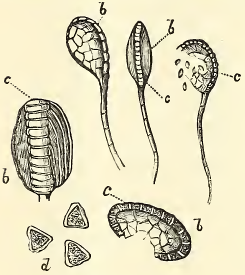

Fig. 9.

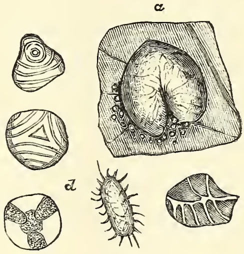

Fig. 10.

carried by the wind to a damp situation, which only delays the process, the elastic ring of each sporangium splits its own covering, causing the spores to fall as almost impalpable dust (fig. 9, *c*, and figs. 9, 10, *d*). If it is desired to collect these sporangia and spores, a piece of white paper about twenty inches by twelve inches must be placed in a dry and clean drawer, the fertile frond of the fern is then laid with the under (*i.e.* the fertile) side next to the paper; after a few days a brown dust will be noticed, this is the sporangia and spores, which can be collected and preserved in a pill-box for future observation and use.

In raising ferns from the spores I have found it most convenient to use small pieces of *perfectly clean* pumice-stone, dust the spores over them, place in flower-pots half filled with *red* sand, cover with squares of glass, embed the pots in the earth quite three-fourths of their depth, choosing if possible a damp, sheltered, north-west aspect. In any case do not make choice of a south or south-east aspect. Water daily without removing the glass, but occasionally, say once a week, *when the weather is dry*, remove it, and wipe off with a *clean cloth* any moisture that clings to the under surface; this is really necessary for the following reason, where damp exists, mould or other forms of minute fungi are sure to appear. They love a close atmosphere, but will not grow to any great extent if it is constantly renewed. The reason for the occasional removal of the glass is therefore obvious, *i.e.* if not removed, the strong growth of moulds would *choke* the more delicate and gradual increase of the minute prothallus of the fern, as drawn at fig. 11, and described at page 19.

To observe the growth of these spores, a good plan is to place in a common flower-pot saucer pieces of chalk, sandstone, or pumice-stone. Over these dust the spores which have been collected as above mentioned, remembering to keep half the quantity for future experiments and microscopical examination; pour in water sufficient to damp the stone by its capillary action, but not to cover its upper surface. Over all place a bell-glass, which must be cleaned once in every three or four days to prevent fungoid growths, or *it may be left uncovered*, though not so favourable for the successful growth of young ferns. In either case the water must be kept up to the mark daily to allow for the evaporation. After a few

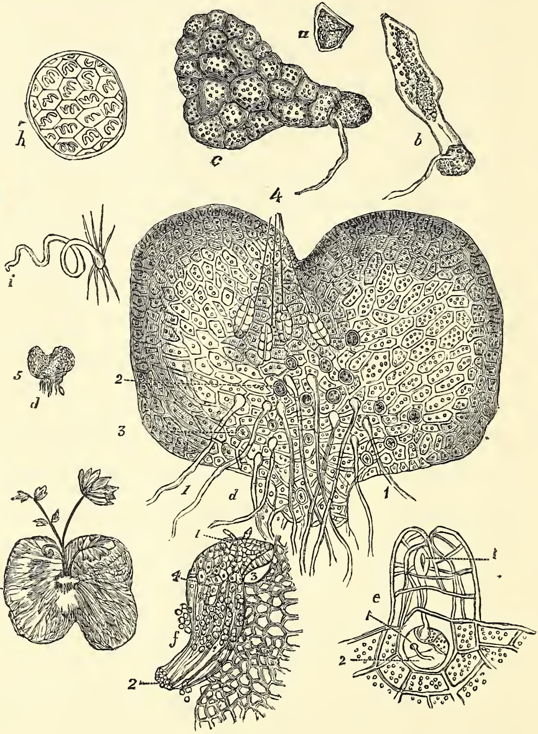

Fig. 11.

weeks a green scum will be perceived on the surface of the stones; the young ferns are beginning to grow, but only the strongest will live. This green scum must now be observed under the microscope. Taking up a small portion with the tip of a needle which has been previously inserted in a small wooden holder, place it carefully in the centre of a glass slip three inches by one inch; cover with a small circle or square of thin microscopical glass, commonly sold by most opticians, and allow water to flow under by capillary action. If this green matter is now observed under the half or quarter inch power of a fairly good microscope, and daily by taking a minute particle from the general mass, the following process of growth can be gradually seen. The first appearance of the green scum under the microscope will show the fern spores (fig. 11, *a*, *b*, *c*) germinating by the protrusion of a tubular-like process of a pale-green colour; from this, by cell-division, gradually enlarges a kind of flat scale (fig. 11, *d*) called the prothallus; when it is completely formed, filamentous rootlets spring from the under side, and if closely observed, some of the cells will be seen to produce antheridia, which answer to the male organs (stamens) of the flowering plants.

These antheridia consist of stalked cellular bodies of simple but peculiar structure, in the interior of which are developed minute cellules (small cells), sometimes called sperm-cells (fig. 11, 2, *h*, *i*). When the antheridia are ripe, the sperm-cells escape, each of the cells containing ciliated spiral filaments called spermatozoids (fig. 11, *h*, *i*). Some time after the *yet immature* antheridia are produced, other reproductive organs called *archegonia*, or ovule-like bodies, are formed in the centre of the prothallus (fig. 11, 4). These are the female organs, which gradually form four cells, in tiers, with a central canal leading to an embryo-sac, in which lies a germinal body, something like, but smaller than, the ovules of higher plants (fig. 11, *e*). This body in course of time becomes fertilized by the entrance of the spermatozoids which are liberated from the sperm-cells of the antheridia (fig. 11, *i*). The embryo-cell having thus become fertile develops into a true embryo, and forms leaves and rootlets (fig. 11, *f*, *g*), which grow and mature until a minute fern is developed, precisely the same in form and structure as the parent plant. Ferns also produce bud-like bodies called *gemmæ* on the leaves of full-grown plants. Though these forms of production cannot be called common, in most species when produced they are not difficult to raise from the bud to the perfect fern. It is a remarkable character of ferns and club-mosses that, though impregnated but once, they yet continue to yield fertile spores year after year, *sometimes*, even to the age of one hundred years.

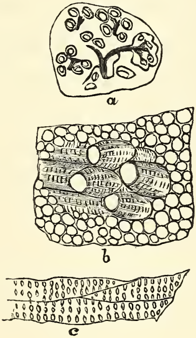

Fig. 12.

The structure of ferns is almost as interesting as their reproductive system.

One of the most remarkable vegetable tissues, called from its peculiar markings, which somewhat resemble the rounds of a ladder, is scalariform tissue (fig. 12).

Though this tissue exists in the stem and other parts of the frond, it is better observed in transverse sections of the root of ferns, in which even the naked eye discerns rows of black dots, with intervals of a lighter colour (fig. 12, *a*). The dots are bundles of cellular and ligneous (woody) tissue, the latter being the vascular tissue of the plant, which is almost entirely composed of scalariform vessels arranged in circular forms. So very characteristic are these vessels that the late Professor Queckett, from a small broken fragment of a funereal urn forwarded to him for examination, containing on its inner surface fibres of a brown colour, found after microscopial investigation that the fibres consisted almost entirely of scalariform vessels (fig. 12, *b*, *c*) precisely similar to those occurring in the Brake Fern (*Pteris*). This fern, he afterwards ascertained, is very abundant in the district in which the urn was discovered, and it is highly probable that portions of the fronds of the fern were placed in the urn before the ashes of the deceased person were deposited in it.

The habitats of ferns are so various that it is almost impossible to give a complete list. The following species must therefore be taken as suggestive, and not as a strict rule to be duly followed: Maiden-hair (*Adiantum Capillus veneris*): this fern is found in moist caves and in the fissures of rocks, especially near the sea-coast; it seems particularly to delight in localities where water trickles down the surface of the rock. Hard Fern (*Blechnum spicant*) is almost universally found, especially in woods, on commons and heaths; being very fond of moisture, it prefers clayey or gravelly soil; it is rarely found on chalk. Common Polypody (*Polypodium vulgare*) may be considered the most common of all native ferns; it is found chiefly on banks, old trees, heaths, commons, etc. (fig. 6.) Holly Fern (*Polystichum Lonchitis*) is almost confined to Yorkshire, and even there in very bleak situations. Mountain Fern (*Allosorus crispus*), as its name implies, is found chiefly in the Highlands of Scotland, though it may occasionally be found in Eridge Woods, near Tunbridge Wells. Common Scale Fern (*Ceterach officinarum*), on rocks and old walls (fig. 8), chiefly in limestone districts, abundant in Somersetshire. Male Fern: this fern, though very common, is plentifully found in rich soils and shady places; it grows larger every year, and the roots often live to a very great age. The Lady Fern (*Asplenium filix-fœmina*) is generally local, sometimes very abundant; it is found in moist woods or sheltered by rocks. Black Maiden-hair Spleenwort (*Asplenium Adiantum-nigrum*): this fern is also very local though common; it is found on rocks, old walls, old buildings, etc. Rue-leaved Spleenwort (*Asplenium Ruta-muraria*): this little fern is very common on old ruins and old churches, especially in towns; it is rarely found growing completely wild, *i.e.* in the country (fig. 7). Hart's Tongue (*Scolopendrium vulgare*) is a really handsome and beautiful fern; though common, it is generally local; it chiefly delights to grow near old wells, but is also often found on damp walls and ruins, damp and shady woods, near streams, etc. Tunbridge Film Fern (*Hymenophyllum Tunbridgense*): this beautiful little moss-like fern is generally found growing on damp rocks in moist and shady places; as its name implies, it was formerly very common on the High Rocks near Tunbridge Wells, but years ago, owing no doubt to a very dry season, large quantities of it fell from the rocks. In some parts of Ireland it is still common, and occasionally found on old and decaying trees. The Royal or Flowering Fern (*Osmunda regalis*): this noble and graceful fern is found in all parts of the British Islands; it prefers bogs and swampy ground, but occasionally occurs in drier localities.

Having thus given a slight clue to the general habitats of most of our *common* British ferns, the subject of their culture must be considered. A Fernery, or, as some persons prefer to call it, a "Rockery" (!), is not so easily made as commonly imagined. It is not sufficient to cast up a bank of earth, and here and there embed a few pieces of stone; it requires to be made on scientific principles. All ferns, though they love moisture, require good drainage. A plan which I have successfully followed is to obtain five or six old tree roots or trunks; if decaying, so much the better. On the required site for the fernery place the largest in the centre, and at a distance of three or four feet the others round it; between these, and also where you wish to bank up, throw a quantity of stone-chippings or broken bricks; if near a sandstone district, sandstone is best. Cover this with a layer of red sand about four or five inches deep, then garden-mould well mixed with decayed pieces of wood, bark, or peat; cover this with bog-moss (*Sphagnum*) (or sand would do), and for the top soil use a mixture of wood-soil (from chestnut-wood is best), sand, and charcoal, or, what is even better, pieces of burned cork; let this upper soil be from eight to twelve inches deep, *as a rule.* Where necessary, a few large stones or pieces of rock may be placed for beauty, but in every case allow for the drainage-water to flow towards the centre, and not to the outside of the fernery, the object being to guard against a dry season by keeping the centre well stored with water. By its evaporation it would then keep up the supply of moisture necessary for the growth of the ferns. If the drainage had been directed towards the outside, the superfluous water would not have been stored, and the result would have been, even if watered daily, a gradual but sure drying up of the roots of the ferns, causing the fronds to wither and die without apparent reason. It is advisable to embed under the surface pieces of grass-turf, in dry seasons these will help to hold moisture.

It will also be advisable to plant some of the following species of wild flowers between the roots of the ferns; this will add to their wild beauty, and at the same time tend greatly to preserve them in vigour of growth by keeping the soil moist. A choice must be made according to the aspect of the fernery and the height of the ferns near by which they are planted. Wood Anemone (*Anemoné nemorósa*), white tinged with purple, six or seven inches in height, damp soil. Pilewort (*Ranúnculus ficária*), yellow, four to seven inches, any soil, but prefers damp. Common Fumitory (*Fumária officinális*), purple, height varies, but rarely over ten inches, prefers well-drained soil. Wallflower (*Cheiranthus cheiri*), various shades, prefers old walls. Large-flowered Bitter Cress (*Cardamíne amára*), white, twelve inches, prefers wet soil. March Violet (*Viola palústris*), pale blue, stem creeping, wet soil. Sweet Violet (*Viola odoráta*), purple or white, prefers banks. Yellow Pansy (*Viola lútea*), prefers exposed situations. Round-leaved Sundew (*Drósera rotundifolia*), fig. 13, flowers small, six inches, moist, mossy ground. Grass of Parnassus (*Parnássia palustris*), large, yellowish-white, eight to ten inches, wet soil. Greater Stitchwort

(*Stellaria Holóstea*), white, about sixteen inches, almost any soil if not too damp, but prefers open aspect.

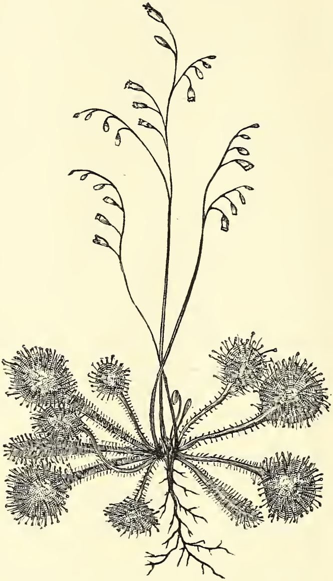

Fig. 13.

Common Flax (*Linum usitatíssimum*), blue, about eighteen inches, prefers rather dry soil. Trailing St. John's Wort (*Hypéricum humifusum*), yellow, old stone walls or dry soil. Herb Robert (*Geránium Robertiánum*), purple, rarely over ten inches, grows almost anywhere. Wood Sorrel (*Oxalis Acetosélla*), white, with purple veins, four to six inches, damp and shady places. Bird's-foot Trefoil (*Lótus corniculatus*), yellow, stem decumbent, exposed, with rather damp soil, slightly sandy. Meadow Vetchling (*Láthyrus praténsis*) yellow, stems two or three feet long, *climbing*, damp soil. Blue Marsh Vetchling (*Lathyrus palústris*). Wood Strawberry (*Fragária vésca*), white, moist ground, but not too shady in aspect. Smooth-leaved Willow (*Epilobium montánum*), purple-rose colour, about ten inches, dry shady aspect. Red-berried Bryony (*Bryonia dioica*), a climbing plant, palmate leaves, almost any soil or aspect. Wall Pennywort (*Cotylédons Umbilicus*), yellowish-green, rocks, stones, or old walls. Stonecrop (*Sedum ácre*), yellow, old stones, trunk of trees, or any moderately dry situation. White Stonecrop (*Sedum album*), white, same situations as last. Hairy Stonecrop (*Sedum villósum*), pale-rose colour, six inches, moist soil, prefers to be near running water. Common Ivy (*Hédera Hélix*), creeper. *N.B.* Very useful in a fernery, especially if young shoots or roots are taken when the ferns are first planted. Sweet Woodruff (*Aspérula odoráta*), white, shady aspect. Small Marsh Valerian (*Valeriána dioica*), rose colour, eight inches, wet soil. Devil's-bit Scabious (*Scabiósa succisa*), purplish-blue, rather damp soil, likes chalk. Mountain Everlasting (*Antennária dioica*), eight inches, mossy ground, open aspect. Colt's Foot (*Tussilága Farfara*), yellow, any

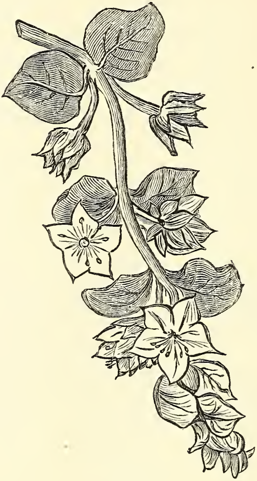

Fig. 14.

moist soil. Common Daisy (*Bellis perennis*), any soil. Rampion Bell-flower (*Campánula Rapúnculus*), blue or white, gravel or sandy soil. Hairbell (*Campanula rotundifolia*), colour and habitat same as last species. Common Ling (*Callúna vulgaris*), purple or white, sandy soil. Common Privet (*Ligustrum vulgare*), white, grows fast and strong, will make fine shelter for delicate ferns, as it will stand almost any soil and bear any cutting when well set. Periwinkle (*Vínca minor*), purplish-blue, a ground creeper, very useful, especially if the fernery is on high ground. Marsh Gentian (*Gentiána Pneumonánthe*), blue, four to ten inches, moist sandy soil. Small Convolvulus or Bindweed (*Convólvulus Arvensis*), rose colour. *N.B.* Though in some cases useful, caution must be used in planting this in any fernery. Being a strong growing plant, it has a tendency to "choke" more delicate growths, and with advantage the Periwinkle may often take its place. But the Great Convolvulus (*Calystégia sepium*), white, is not open to these great objections; being a creeper, and growing in almost any moist soil, it will be found very useful, especially if the "fernery" is made near a clump of trees or shrubs.

Another very useful ground creeper is the Money-wort Loose-strife (*Lysimachia Nummularia*), fig. 14; its graceful festoons adorned with glossy leaves and large yellow flowers will always make the fernery attractive, but as it is a quick grower too much of it must not be planted, especially when the fernery is first made. Also, if there is any part of the fernery especially moist, the Creeping Water Forget-me-not (*Myosotis palustris*) can be made to grow well. It is scarcely possible to give it too much water. Many other species of wild plants can also be added, but I have mentioned some of the best.

If possible, choose the site of the fernery under trees, or the north-east aspect of a wall, leaving the north and east aspects well open, and the south and west partially protected from the full rays of the sun. Having thus made the fernery, our next object is to plant ferns as nearly as possible according to their habitats. Though not difficult, this requires care, and if it is desired to make the "fernery" a lasting testimony of our skill and taste, it would be better to insert each fern in a flower-pot or cocoa-nut shell filled with the necessary soil fitted for its growth; but if we trust to the chances of growth, a space may be made in the upper soil of the "fernery," lined with damp bog-moss (*Sphagnum*), the fern placed in and embedded with a light peaty soil. Trusting, however, that our readers wish for complete success, we suggest that they use the following plan: In the case of small ferns, when you collect, it is better to take a few halves of cocoa-nut shells or cocoa-nut fibre, also a good strong trowel and geological hammer. Having thus provided against difficulties, we start on our imaginary journey to collect a few of the common British ferns. We collected the following species, and made a note of the soil and habitat as we found them growing:—

Maiden-hair Fern—Loam, leaf-mould, and silver sand, mixed pieces of sandstone for subsoil; find this grows well if planted in cocoa-nut shells, and hung on damp wall, west aspect.

Hard Fern—Stiff clayey soil; the only fern that grows well in this soil, or in loam and peat; on rockwork, north side; give plenty of air and moisture.

Brake Fern—Grows well in peat, or earth taken from a heath or common; in taking it from its habitat use great care.

Common Polypody (fig. 6)—Remove from old trees with care, using saw-knife or chopper; it likes plenty of decayed wood and leaf-mould; give it air.

Holly Fern—Difficult to grow outdoors; water the root only, do not touch the fronds; in planting keep the crown well up; let the soil be peat and sandy loam, using plenty of pieces of sandstone.

Mountain Fern—Soil, yellow loam; give plenty of air and moderate amount of water.

Male Fern—Very easy to grow, but prefers light rich soil.

Lady Fern—Soil light and peaty; give any amount of water, it is hardly possible to give too much in the summer season.

Black Spleenwort—Plant in sandstone, using light sandy soil; north aspect; plenty of air, and not too much water.

Maiden-hair Spleenwort—Grows best in the crevices of bricks or stones; north aspect.

Wall or Rue-leaved Spleenwort (fig. 7)—Remove with very great care; plant in old mortar and pieces of old bricks; it succeeds best on an old wall; do not touch or water much.

Hart's Tongue—Free soil, shade, and moisture.

Tunbridge Film Fern—This fern can only be well grown under glass. Fill an ordinary flower-pot with wet bog-moss (*Sphagnum*) and invert it, then mix fine sand, loam, and peat-earth, saturate with water, and mix to a kind of mortar; plaster this all over the inverted pot, arrange the roots of the Film Ferns over the surface of the mortar, then fill a saucer with *wet* bog-moss and cover its surface with fine sand. On this place the inverted flower-pot and cover with a bell-glass, the ring of which will sink into the Sphagnum contained in the saucer.

The Royal Flowering Fern (*Osmunda regalis*), fig. 3, though really a bog fern, will live in the ordinary soil of any garden, but to make it thrive care must be taken to supply peat or bog earth, and it can scarcely have too much water.

Surrounding most of these species of fern, club and other mosses may be cultivated. Many of the common species, such as the Tortulas, Bryums, Hypnums, etc., may with care be brought to luxuriant growth, other species will be found more difficult. Here and there grass-seed may also be thrown. The object of growing these, apart from their beauty, is to keep the ground moist round the roots of the ferns, for with few exceptions, as above mentioned, they delight in a damp soil, if well drained.

An atmosphere between 60° and 70° Fahrenheit is best suited for most ferns, but this is impossible to obtain in our wayward climate.

In watering ferns always use rain-water if possible; if not, use water that has stood for hours in the sun. Remember always that all plants, more especially ferns, require more water the hotter the weather. The time of watering is immaterial, but do not water in hot sunshine, otherwise the fronds will gain a sickly yellowish tint. It is better to use a syringe or any other apparatus that will give a spray of water; the old-fashioned watering-pot gives out too much water at once, causing the earth to be partially washed away from the roots, especially if the fern is a minute species.

Many persons prefer to grow the most delicate ferns in Wardian cases. I have found Dick, Radclyffe, & Co., 129 High Holborn, London, W.C., the best makers, often choosing them in preference to green or hot houses, being more under personal control, allowing the temperature to be raised or lowered, and various delicate experiments to be made which would be a physical impossibility in an outdoor fernery, or even in a green or hot house. Very small ferns, such as the Tunbridge Film Fern, are perhaps better isolated according to their size in separate pots, covered with bell-glasses; but for ferns from five to twelve or fourteen inches growth, a Wardian case as follows will be found preferable; they may be constructed of every shape and size according to the taste or means of the grower. A convenient size suitable for nearly every window (see title-page), three feet long, two feet high, and one foot wide. At the bottom of this case a box lined with glass or slate, the latter being the best, having a small hole with india-rubber tube to carry off waste drainage. The box is covered for about two inches with rough stones or broken earthenware, then about two inches of turf-soil, covered with four or five inches of a mixture of peat, sand, and rich garden-soil. This composition is of course intended to represent as far as possible a natural fertile soil, suitable for the growth of most ferns (see title-page). Over this box is fitted a glass cover, and the lighter the glass frame and the finer the glass, the better for the general view and health and growth of the plants placed under its shelter. As a rule, a west or north-east aspect is best for a Wardian case. Even north is better than south, as ferns will not stand too much sun. Wardian cases after the first planting require comparatively but little care. They make their necessary moisture from the daily influence of the sun's rays; their atmosphere also is suitable for them, and with occasional watering, say once a week, and wiping the inside of the glass once a fortnight, the ferns will be found to grow well and prove a perfect success. If not convenient to have the Wardian case in any window, they may be placed in any situation, requiring only seven or eight hours of *good daylight.* It will be necessary to have a small ventilator at the top of the case, which can be opened at will to regulate the inside temperature.

Apart from the Wardian case many common (hardy) species of ferns can be grown either in standing pots, which should be constantly turned, or hanging pots. Dick, Radclyffe, & Co., as previously mentioned, supply capital hanging pots. These hanging pots are very useful, for even moderately dark corners of any room may thus be brightened, with benefit to health, taste, taking up but little room and giving even less trouble.

For remarkable and abnormal growths, ferns are more subject to these freaks of Nature than almost any other class of plants. For one case of abnormal growth (natural) in the flowering plants, we at least come across four or five in the ferns, taking plant for plant in equal numbers; in fact, we may say the ferns are the "Pandora Box" of Nature, beauty of form and strength of growth being their well-known characteristic. In technical language these abnormal growths are called "Sporting" or "Bifurcation." Ferns, as a rule, are not subject to insect "pests;" the only insect that I am aware of is the thrips. These little "nuisances" often attack the under side of the fronds, but they are soon killed by syringing with a mixture, one part glycerine to forty or fifty parts water, the next day giving the ferns a good watering with pure water to carry off waste matter from the surfaces of the fronds, ferns being more delicate in this respect than other plants.

The uses of ferns are various, though none are very important. The long creeping rhizoma of a variety of *Pteris aquilina* was formerly much used in New Zealand for food, as it abounds in starch and mucilage. The large rhizoma of *Marattia salicina* is eaten when prepared in the same way as the Pteris, thus: The rhizoma, after being washed and peeled, is scraped so as to avoid including the hard-walled tissue, and then mixed with a sufficient quantity of water; the mucilage will be dissolved, and after a few hours may be decanted. A little colourless, tasteless mucilage will pass off on a second washing, and the residue, when baked, is palatable and also very nutritious. In cases of famine all the Bracken genera would thus become useful. *Nephrodium filix-mas* is still used as an occasional and often valuable remedy for tapeworms, and the downy-like scales from a species of Cibotium is used in Germany as a styptic under the name of "Penghawar Djambi." A similar substance largely used in Madeira for stuffing cushions is gathered from *Dicksonia Culcita*. Other species of ferns are used by the Indian women of Peru for perfumes.

Ferns and mosses have been found in great abundance in coal, carboniferous limestone, and other geological formations, but rarely in fruit. The species are apparently very numerous, but it is thought by Dr. Hooker that many of them were arboreous; in fact, similar in form to the tree-ferns of tropical countries.

A well-prepared collection of dried ferns, apart from its botanical use, forms an interesting series of objects of beauty even to the casual observer. In collecting ferns for this herbarium, care must be taken that the crown and root are secured as well as the fronds, even if these have no fruit (*sori*) on them; they must not on that account be passed, as the fronds that are not fertile often have a specific character which mark the genera, species, or variety.

As most of our readers must be aware, plants are prepared for the herbarium by being laid between sheets of blotting-paper and placed under pressure. Blotting-paper is an excellent material, but according to my own experience, old newspapers—not the *Times*—are nearly, if not quite, as good, and also much cheaper. A quicker method is to place the frond between newspapers and iron with hot iron until all the moisture has been extracted, using a very hot iron at first, and less so as the frond gradually dries. This is necessary, for if the extreme heat was equally used, at the termination of the process the frond would have a scorched appearance, whereas with gradual heat most of the delicate tints are well preserved.

In making a good collection of ferns, the habitat, date of collection, name, soil, etc., must be written on a small label and placed at the bottom left-hand corner of each separate sheet. The most convenient size for the sheets is twenty by twelve inches. After the fern has been well dried, it must be lightly brushed over with a strong solution of gum-arabic, placed gently in a natural position on the paper, and subjected to pressure. Examples of both barren and fertile fronds must be mounted on the same sheet, if possible, together with any important character of the root, stem, or fruit (see figs. 1, 2, *c*). These are best placed on the left-hand side of the paper.

If the cost is not an object, these specimens keep better, and are also more convenient, when stored in a number of shallow trays, twenty-one by thirteen inches, inside measure. These trays may be kept in a box or a cabinet made on purpose for them ; or if the expense is an object, they may be kept in a portfolio or drawer, taking care that they are protected from dust and insects.

All of our readers that possess a microscope should study the minute tissues of ferns and mosses, especially the reproductive organs and the fruit. Endless half-hours may thus be well filled with pleasure and instruction.

As mentioned in the early part of this article, the growth of the young fern ought to be daily observed under the microscope (fig. 11), but it is also advisable to keep a few specimens duly prepared for the microscope. It is not possible to give the entire process here, but the following is a rough outline. Longitudinal and transverse sections must be cut from the root with a fine scalpel or razor ; these sections must be cut very thin, one of them mounted in Canada balsam, the other in glycerine jelly. The section that has to be mounted in the balsam requires to be first transferred to pure alcohol (spirits of wine), and allowed to remain five or six hours ; then it should be transferred to turpentine, in which it must be allowed to soak for three or four days, then transferred to a clean glass slip three by one inch, a drop of Canada balsam placed on it, and a small square or circle of microscopic thin glass placed over; give slight pressure with a wire clip until the balsam is dry, which will take a week or more.

The other section, which is to be mounted in jelly (Deane's glycerine jelly is the best), must be placed in water for a few hours, then transferred to pure glycerine, allowed to soak for a day or two, and then mounted in the jelly thus: With a penknife take from the bottle a piece about the size of a pea, place this in the centre of a glass slip three by one inch, warm the slide near a fire or over a small lamp until the jelly is dissolved, take the root section from the glycerine, drain off the glycerine and transfer to the jelly, cover with a circle of thin glass, and when quite set cover the edge of the thin glass with india-rubber cement. Both the upper and under cuticles of the frond ought also to be mounted. After cutting a small portion, half inch or less square, boil it in a test-tube with nitric acid and water in the proportion of one acid to six parts water. After a few minutes the cuticles will be seen to separate from the central tissues. Well wash in warm water, soak in glycerine, and mount in glycerine jelly. The various parts of the fruit (*sori*), figs. 9, 10, may also be mounted dry in a cell in Canada balsam or in jelly.

For fancywork and decoration the uses of ferns are endless. One of the most attractive is the ornamentation of glass. Choose a good frond of the Male Fern (*Lastrea filix-mas*), or any other fern having a graceful outline; slightly coat the surface of the glass with a film of varnish consisting of gum-water nineteen parts, glycerine one part; allow it to dry. Now take a piece of sized-paper fourteen by ten inches, cover this with printer's ink, using a rubber; lay the frond of the fern upon it and subject to great pressure for about thirty or forty minutes; remove from the paper and place upon the prepared glass, having previously breathed slightly upon the surface of the glass; it will now adhere. Take a "dapper" made of cotton wool covered with wash-leather, and dap the frond sharply for ten minutes or more, then gently remove the frond, when, if well done, a sharp and well-printed outline will appear on the glass. This may be tinted with colours or not as taste requires. When quite dry it is better to give it a slight coat of Canada balsam varnish.

We have tried to give our readers a glimpse of a few graceful plants of our native Flora, in the hope that it will lead them to a path of pleasure, beauty, and healthful work, remembering that if any subject, however small, is made to bear fruit to the worker, it will be found to contain useful matter both to the student and to the lover of Nature, exhaustless in her work.

DESCRIPTION OF ILLUSTRATIONS.

Frontispiece.—WARDIAN CASE.

Fig. 1. Illustrating POLYPODIACEÆ.—1. Sori, *Polypodium vulgare* (POLYPODIEÆ). 2. Sori, *Gymnogramma leptophylla* (GYMNOGRAMMEÆ). 3. Indusium covering sori, *Polystichum angulare* (ASPIDIEÆ). 4. Indusium and exposed sori of *Scolopendrium vulgare* (ASPLENIEÆ). 5. Exposed sori, generally covered by linear indusium, *Blechnum spicant* (BLECHNEÆ).

Fig. 2. Illustrating POLYPODIACEÆ.—6. Sori, *Pteris aquilina* (PTERIDEÆ). 7. Indusium and sori, *Adiantum capillus veneris* (ADIANTEÆ). 8. Indusium covering sori, *Cystopteris fragalis* (CYSTOPTERIDEÆ). 9. Hairlike indusium, *Woodsia* (WOODSIEÆ). 10. (*a*) Urn-shaped fruit protecting sori, *Trichomanes;* (*b*) a valved expansion protecting the sori on the surface of the frond, *Hymenophyllum* (HYMENOPHYLLEÆ).

Fig. 3. Illustrating OSMUNDACEÆ.—*Osmunda regalis: a*, Spore-cases more highly magnified (OSMUNDACEÆ).

Fig. 4. *Ophioglossum vulgare: a*, Spike containing spore-cases more highly magnified (OPHIOGLOSSACEÆ).

Fig. 5. Common Scale Fern (*Ceterach officinarum*).

Fig. 6. Common Polypody (*Polypodium vulgare*).

Fig. 7. Wall Rue or Wall Spleenwort (*Asplenium Ruta-muraria*).

Fig. 8. Common Maiden-hair Spleenwort (*Asplenium Trichomanes*).

Fig. 9. *b*, Sporangium. *c*, Annulus. *d*, Spores from different species of fern.

Fig. 10. *a*, Showing reniform indusium of male fern. *d*, Various spores from native and foreign ferns, illustrative of their various forms and structure.

Fig. 11. *a*, Spore of *Pteris aquilina*. *b*, *c*, Growth of the spore. *d*, Prothallus, or pro-embryo of Pteris, magnified: 1, root-fibres; 2, antheridia; 3, same after discharging contents; 4, pistillidia or archegonia; 5, natural size of prothallus. *e*, Pistillidium of Pteris, magnified: 1, spermatic filament; 2, embryo-sac. *f*, Development of the embryo of a fern: 1, leaf; 2, root; 3, bud; 4, leaf-stalk. *g*, Young seedling fern, Pteris. *h*, Antheridium containing spiral spermatic filaments. *i*, A spermatic filament more highly magnified.

Fig. 12. *a*, Section of root, *Pteris aquilina*. *b*, Scalariform tissue *in situ*, slightly magnified. *c*, The same tissue more highly magnified.

Fig. 13. Round-leaved Sundew (*Drosera rotundifolia*).

Fig. 14. Money-wort, Loose-strife (*Lysimachia Nummularia*).

SYNOPSIS OF THE GROUPS OF BRITISH FERNS, INCLUDING THE MINOR SECTIONS.

POLYPODIACEÆ.

This large group of ferns are chiefly remarkable from their leaves being rolled up in a circinate manner whilst the frond is young, and also by the spore-cases containing within their structure an elastic ring called the *annulus* (see fig. 9). The following minor sections comprise the order:—

POLYPODIEÆ.

Round clusters of spore-cases having no special cover, *indusium* (fig. 10, *a*) (fig. 1).

GYMNOGRAMMEÆ.

Linear clusters of spore-cases having no special cover (fig. 2).

ASPIDIEÆ.

Sori, or spore-cases having indusium of a circular form generally springing from the back of the veins (fig. 3).

ASPLENIEÆ.

Having spore-cases with special indusia of an oblong form springing from the sides of the veins (fig. 4).

BLECHNEÆ.

Sori, having special indusia forming linear growth between the midrib and margins of the divisions of the frond (fig. 5).

PTERIDEÆ.

In this case the margin of the frond is continuously or interruptedly changed into a kind of indusium (fig. 6).

ADIANTEÆ.

The margin of the fronds bear reflexed lobes, changed into indusia, under which are the spores (fig. 7).

CYSTOPTERIDEÆ.

Having special ovate and hoodlike indusia affixed behind and covering the sori (fig. 8).

WOODSIEÆ.

Sori generally covered by an indusium having hairlike bodies attached to its margin (fig. 2, 9).

HYMENOPHYLLEÆ.

Sori are generally produced around the end of veins which project from the frond; these are either urn-shaped or consist of a two-valved membranous sac (fig. 2, 10, *a*, *b*).

OSMUNDACEÆ.

Chief characteristic: Young leaves circinate; the spore-cases are also destitute of an elastic ring or annulus (fig. 3).

OPHIOGLOSSACEÆ.

This group is chiefly remarkable for having the leaves folding straight; spore-cases *generally* in a spike, without an elastic ring, and two-valved (fig. 4).

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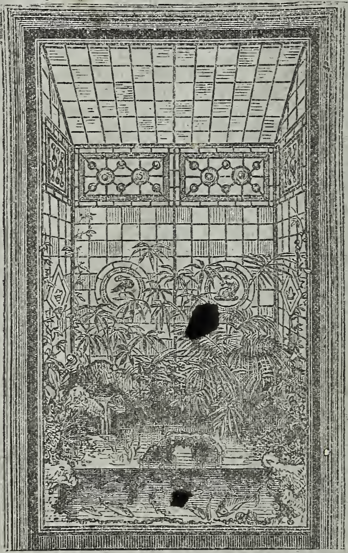

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